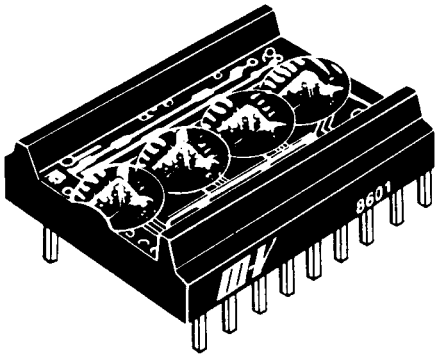


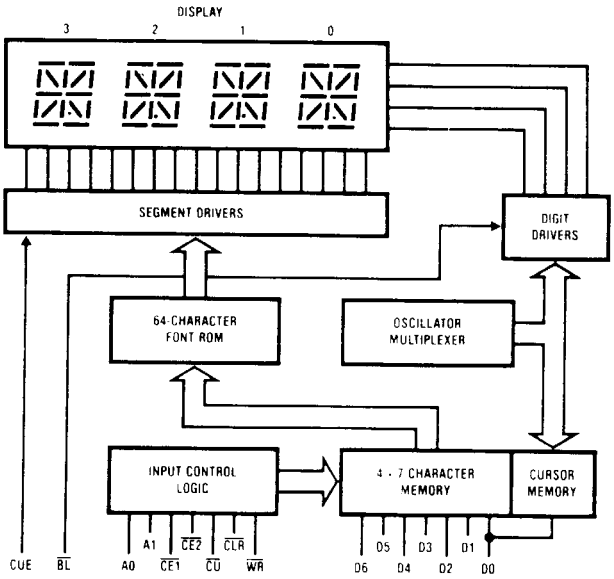
## FEATURES

- Internal Memory, Decoder, Multiplexer & Driver
- 17th Segment for Improved Punctuation Marks
- End-Stackable
- Microprocessor Bus Compatible
- Compatible TTL Inputs and Power Supply
- 4 Red Characters Magnified to 0.160"
- Wide Viewing Angle ±50°
- 64-Character ASCII Format
- Rugged Package—Totally Plastic Encapsulated
- Independent and Asynchronous Digit Access
- Independent Cursor Function
- Memory Clear and Display Functions
- Intensity Coded for Uniform Displays

## ABSOLUTE MAXIMUM RATINGS

| | |
|---|---|
| Voltage at Any Pin: | **-0.3V to $V_{CC}$ +0.3V** |
| Operating Voltage Range ($V_{CC}$): | **3.0V to 6.0V** |
| Operating Temperature: | **-40° C to 85° C** |
| Storage Temperature: | **-40° C to 85° C** |
| Relative Humidity at 60° C: | **90%** |
| Absolute Maximum $V_{CC}$: | **6.5V** |

## BLOCK DIAGRAM




## DESCRIPTION

The DL2416/TSM2416 has four 17 segment alphanumeric display digits and an internal CMOS driver.

The four 17 segment monolithic LEDs are magnified by an immersion bubble lens system.

The integrated CMOS drive chip has memory to store four 7-bit ASCII words (corresponding to the four digits), an ASCII to 17 segment alphanumeric ROM decoder, and multiplexing and drive circuitry to drive the four 17 segment monolithic digits. Inputs and power supply requirements are TTL compatible. Data can be entered directly from a microprocessor bus without additional interface circuitry. Data can be written asynchronously through the seven bit data bus into a digit location addressed by the two-bit address bus.

Two or more DL2416/TSM2416s can be assembled in series by connecting data lines in parallel to the data bus. Similarly, address lines are connected in parallel to the address bus. Write and cursor lines are also paralleled. Two chip enables are used to select the desired 4-digit group in up to four individual displays (up to sixteen digits). For displays requiring more than 4 displays (16 digits), extended addresses can be obtained with a 1 or N decoder IC.

The cursor function causes 16 of the 17 segments of a digit to light without disturbing the contents of the memory for that digit. When the cursor is removed, the character previously displayed returns. A cursor enable CUE is provided for flexibility of control.

# ALPHANUMERIC INTEGRATED DISPLAY
## DL2416/TSM2416

## DC ELECTRICAL CHARACTERISTICS

| Symbol | Parameter | Conditions | -40°C | | | 25°C | | | 85°C | | | Units |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | Min. | Typ. | Max. | Min. | Typ. | Max. | |
| $V_{CC}$ | Supply Voltage | | | | | 4.5 | | 5.5 | | | | V |
| $I_{CC}$ | Supply Current—4 Digits on (10 Seg/Dig) | $V_{CC}$ = 5.0V | | 75 | 150 | | 65 | 120 | | 50 | 90 | mA |
| $I_{CC(\overline{CU})}$ | $I_{CC}$ Cursor (16 Seg/Dig) | $V_{CC}$ = 5.0V | | 95 | 180 | | 85 | 160 | | 65 | 140 | mA |
| $I_{CC(\overline{BL})}$ | $I_{CC}$ Blank | $V_{CC}$ = 5.0V, $\overline{WR}$ = 5.0V, $V_{IN}$ = 0 | | 1.0 | 2.7 | | 0.9 | 2.4 | | 0.6 | 2.1 | mA |
| $I_{IL}$ | Input Current, Max. | $V_{CC}$ = 5.0V, $V_{IN}$ = 0.8V | | 30 | 120 | | 25 | 100 | | 20 | 80 | μA |
| $V_{IL}$ | Input Voltage, Low | $V_{CC}$ = 5.0V ±0.5V | | | 0.8 | | | 0.8 | | | 0.8 | V |
| $V_{IH}$ | Input Voltage, High | $V_{CC}$ = 5.0V ±0.5V | 2.4 | | | 2.4 | | | 2.4 | | | V |

## AC TIMING CHARACTERISTICS Guaranteed Minimum Timing at Specified Temperatures at $V_{CC}$ = 4.5V.

| Symbol | Parameter | -40°C | 25°C | 85°C | Units |
|---|---|---|---|---|---|
| $t_{AS}$ | Address Set Up Time | 240 | 300 | 360 | ns |
| $t_{WD}$ | Write Delay Time | 45 | 60 | 75 | ns |
| $t_W$ | Write Time | 195 | 240 | 285 | ns |
| $t_{DS}$ | Data Set-Up Time | 80 | 100 | 120 | ns |
| $t_{DH}$ | Data Hold Time | 40 | 50 | 60 | ns |
| $t_{AH}$ | Address Hold Time | 0 | 0 | 0 | ns |
| $t_{CLR}$ | Clear Time | 0.8 | 1.0 | 1.2 | μs |
| $t_{CES}$ | Chip Enable Set-Up Time | 240 | 300 | 360 | ns |
| $t_{ACC}$ | Access Time | 280 | 350 | 420 | ns |
| $t_{CEH}$ | Chip Enable Hold Time | 0 | 0 | 0 | ns |

## OPTICAL CHARACTERISTICS $T_A$ = 25° C

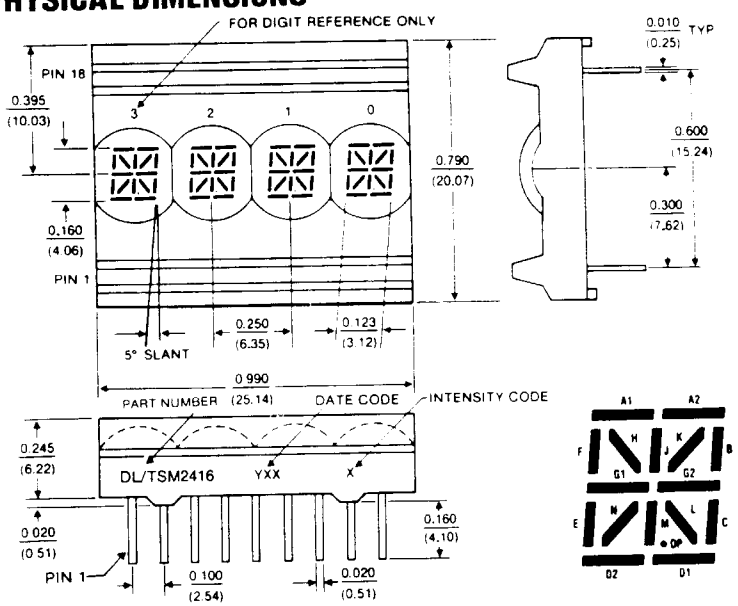
| Parameter | Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|
| Luminous Intensity per Digit | $V_{CC}$ = 5.0V, 8 Segs On | 0.5 | 1.0 | | mcd |
| Intensity Matching, Within a Digit | $V_{CC}$ = 5.0V | | ±33 | | % |
| Off-Axis Viewing Angle | $V_{CC}$ = 5.0V | | ±50 | | degrees |
| Digit Size | | | 160 | | mils |
| Peak Wavelength | $V_{CC}$ = 5.0V | | 655 | | nm |

| Pin No. | Electrical Connection |
|---|---|
| 1 | $\overline{CE1}$ Chip Enable 1 |
| 2 | $\overline{CE2}$ Chip Enable 2 |
| 3 | $\overline{CLR}$ Clear |
| 4 | $\overline{CUE}$ Cursor Enable |
| 5 | $\overline{CU}$ Cursor Select |
| 6 | $\overline{WR}$ Write |
| 7 | A1 Digit Select |
| 8 | A0 Digit Select |
| 9 | $V_{CC}$ |
| 10 | GND |
| 11 | D0 Data Input |
| 12 | D1 Data Input |
| 13 | D2 Data Input |
| 14 | D3 Data Input |
| 15 | D6 Data Input |
| 16 | D5 Data Input |
| 17 | D4 Data Input |
| 18 | $\overline{BL}$ Blanking |

DIMENSIONS: INCHES (Millimeters)

TOLERANCES: 0.XXX ±0.010 (X.XX ±0.25)

## PHYSICAL DIMENSIONS



# ALPHANUMERIC INTEGRATED DISPLAY
## DL2416/TSM2416

## FUNCTION DESCRIPTION

| Control | | | | | | | Address | | Data Input | | | | | | | Digit | Digit | Digit | Digit |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $\overline{BL}$ | $\overline{CE1}$ | $\overline{CE2}$ | CUE | $\overline{CU}$ | $\overline{WR}$ | $\overline{CLR}$ | A1 | A0 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | 3 | 2 | 1 | 0 |
| H | X | X | L | X | H | H | | | Previously Loaded Display | | | | | | | F | O | U | R |
| H | H | X | L | X | X | H | X | X | X | X | X | X | X | X | X | F | O | U | R |
| H | X | H | L | X | X | H | X | X | X | X | X | X | X | X | X | F | O | U | R |
| H | L | L | L | H | L | H | L | L | H | L | L | L | H | L | H | F | O | U | E |
| H | L | L | L | H | L | H | L | H | H | L | L | H | H | H | L | F | O | N | E |
| H | L | L | L | H | L | H | H | L | H | L | L | H | L | L | H | F | I | N | E |
| H | L | L | L | H | L | H | H | H | H | L | L | H | H | H | L | N | I | N | E |
| L | X | X | X | X | H | H | X | X | Blank Display | | | | | | | | | | |
| H | L | L | L | H | L | H | H | H | H | L | L | H | H | L | L | L | I | N | E |
| H | X | X | L | X | H | L | X | X | Clears Character Displays | | | | | | | | | | |
| H | L | L | L | H | L | H | X | X | See Character Code | | | | | | | See Character Set | | | |

**Loading Data**—Data entry may be asynchronous and random. $\overline{CE1}$ and $\overline{CE2}$ must be held low and $\overline{CU}$ must be held high to enable data entry. The data code (D0-D6), which selects one of the 64-character sets and digit address (A0-A1) are held stable while $\overline{WR}$ is held low. This stores the appropriate character from the character set into the digit specified by A0 and A1. This data is maintained for that digit until new data is entered.

X = Don't care.

| Control | | | | | | | Address | | Data Input | | | | | | | Digit | Digit | Digit | Digit |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $\overline{BL}$ | $\overline{CE1}$ | $\overline{CE2}$ | CUE | $\overline{CU}$ | $\overline{WR}$ | $\overline{CLR}$ | A1 | A0 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | 3 | 2 | 1 | 0 |
| H | X | X | L | X | H | H | | | Previously Loaded Display | | | | | | | B | E | A | R |
| H | X | X | H | X | H | H | | | Display Previously Stored Cursors | | | | | | | B | E | A | R |
| H | L | L | H | L | L | H | L | L | X | X | X | X | X | X | H | B | E | A | ▨ |
| H | L | L | H | L | L | H | L | H | X | X | X | X | X | X | H | B | E | ▨ | ▨ |
| H | L | L | H | L | L | H | H | L | X | X | X | X | X | X | H | B | ▨ | ▨ | ▨ |
| H | L | L | H | L | L | H | H | H | X | X | X | X | X | X | H | ▨ | ▨ | ▨ | ▨ |
| H | L | L | H | L | L | H | H | L | X | X | X | X | X | X | L | ▨ | E | ▨ | ▨ |
| H | X | X | L | X | H | H | | | Disable Cursor Display | | | | | | | B | E | A | R |
| H | L | L | L | L | L | H | H | H | X | X | X | X | X | X | L | B | E | A | R |
| H | X | X | H | X | H | H | | | Display Stored Cursor | | | | | | | B | E | ▨ | ▨ |

**Entry Into Cursor Memory**—This is accomplished by setting the $\overline{CE1}$ and $\overline{CE2}$ inputs—as well as the $\overline{CU}$ input—low. The cursor memory consists of 4 bits corresponding to the four digits, each one addressable by way of the A0 and A1 inputs. Once the address and data are stable, the $\overline{WR}$ input must go high and the cursor memory will respond to the D0 input. That is, if D0 is high, a cursor will be written and if D0 is low, the cursor will be erased. $\overline{CLR}$ will not erase a cursor. A cursor will only be displayed when CUE is high and the cursor function can be bypassed by tying CUE low. A flashing cursor can be implemented by pulsing CUE; this results in alternately displaying the cursor and the character originally written in that digit. Cue will not alter the contents of either the cursor or data memory.

Note: Cursor must be cleared during power up.

X = Don't care.

**Illegal Code**—If an illegal ASCII code is entered as the data code (i.e., D6 = D5) the display will automatically be blanked for the corresponding digit.

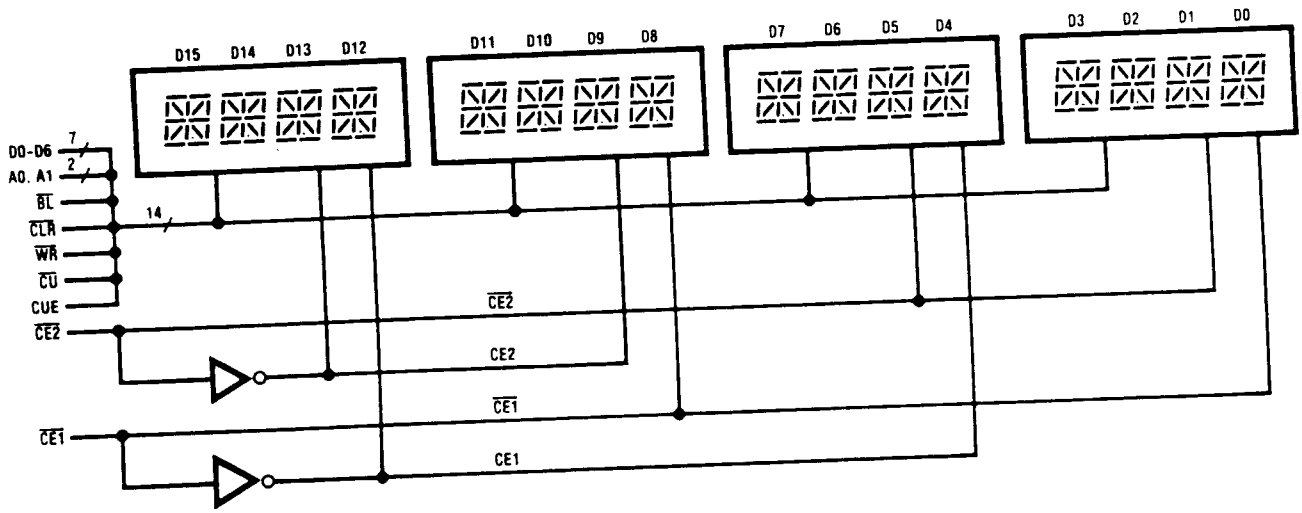
**Initializing and Clearing the Display**—To initialize the device after power-up, enter a legal data code set (D6 ≠ D5), and then clear cursors for each digit. Alternately, all internal data memories can be cleared by holding CLR low for 1 $\mu$s. This will not clear the cursor memories.

**Display Blanking**—In addition to blanking of the display by loading a blank or space into each digit data memory, this may be accomplished by setting the display blank input $\overline{BL}$ low. This will not affect the contents of either the data or cursor memories.

# ALPHANUMERIC INTEGRATED DISPLAY
## DL2416/TSM2416

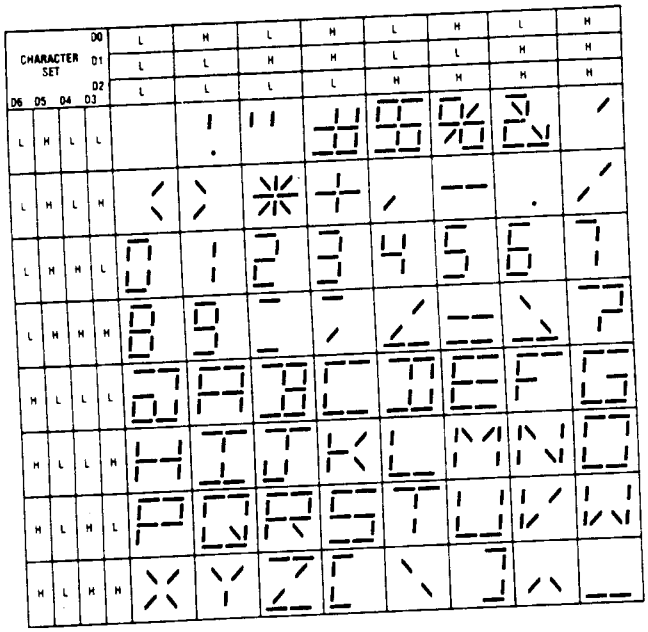


### TYPICAL APPLICATION CIRCUIT

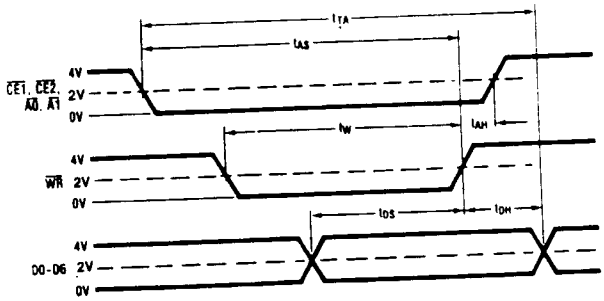



Interconnect for ≤ 16 Digit Systems

### CHARACTER SET




### TIMING DIAGRAM




The DL2416/TSM2416 is a CMOS device and normal precautions should be taken to avoid static damage.

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